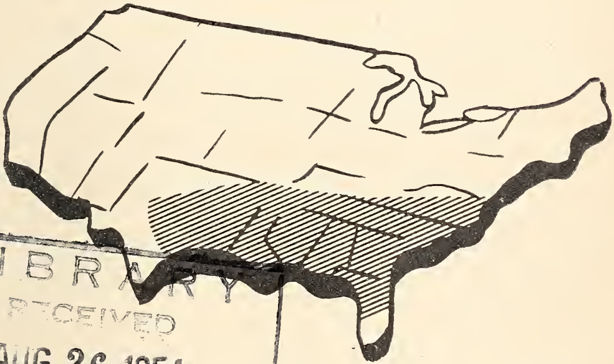
Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

942
t. 1
943

Factors Affecting Time of Planting Soybeans in the Southern States



LIBRARY
RECEIVED
AUG 26 1954
U. S. DEPARTMENT OF AGRICULTURE
BELTSVILLE BRANCH

by Edgar E. Hartwig

Circular No. 943

UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D. C. July 1954

CONTENTS

Studies at Stoneville, Miss.

Page

Factors to be considered in determining planting date........ 1
  Soil temperature.. 1
  Day length.. 2
  Rainfall in the spring.................................. 3

Plan of studies... 3

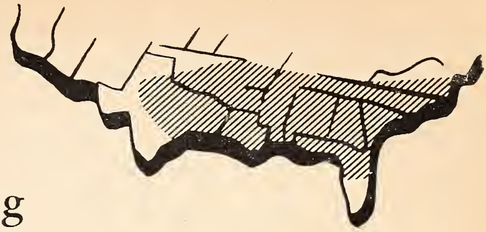
Results... 4
  Growth rate... 4
  Time of blooming.. 5
  Plant height.. 5
  Length of fruiting period............................... 7
  Date of maturity.. 8
  Seed yield.. 10
  Seed quality.. 11
  Chemical composition of the seed........................ 11

West Florida results...................................... 12

Summary... 12

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 10 cents

Circular No. 943



Factors Affecting Time of Planting Soybeans in the Southern States

By Edgar E. Hartwig

Agronomist, Field Crops Research Branch, Agricultural Research Service [1]

In recent years interest in production of soybeans for beans has increased appreciably in the Southern States. The study summarized in this circular was designed to give basic information on rate of emergence, rate of growth, total growth, seed yield, and composition of seed, where soybeans are planted over a long range of time, as is possible in the southern region. Studies were conducted at the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Miss., during the 3-year period 1949–51. Over the 3-year period, considerable differences in rainfall pattern were encountered. However, results in each of the 3 years were essentially similar.

Yield data from a time-of-planting study are also given for western Florida in 1952.

STUDIES AT STONEVILLE, MISS.

Factors To Be Considered in Determining Planting Date

Soil Temperature

Studies conducted under controlled conditions in the greenhouse have shown that soybean plants grown in nutrient solution with a root temperature of 45° F. made only 23 percent as much growth in a 27-day period as plants grown under comparable conditions but with a root temperature of 63°.

In early April air temperatures during the day frequently are above 80° F. At Stoneville, Miss., records on minimum soil temperatures at planting depth following each planting date show that the soil is still cold during April (table 1). For each of the 3 years 1949–51, the pattern was similar. At 47°, as encountered in early April, soybeans germinate very slowly.

---

[1] The experiments were conducted by the U. S. Regional Soybean Laboratory in cooperation with the Delta Branch of the Mississippi Agricultural Experiment Station. Paper 237, U. S. Regional Soybean Laboratory, and 338, Mississippi Agricultural Experiment Station.

TABLE 1.—*Mean minimum soil temperature at Stoneville, Miss., for the 5-day period following planting for the years 1949–51*

Year	5-day soil temperature following planting date of—							
	Apr. 10	Apr. 20	May 1	May 10	May 20	June 1	June 10	June 20
	° F.	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*
1949	47	57	65	64	71	74	70	75
1950	47	54	71	66	69	72	73	77
1951	47	59	70	65	70	72	71	73
Mean	47	57	69	65	70	73	71	75

Day Length

The soybean long has been recognized as a plant very sensitive to day length. With 12 hours of daylight, nearly all varieties begin flowering 21 to 28 days after emergence. With long days the soybean plant continues to make vegetative growth and under field conditions starts to flower when the period of daylight has shortened below a critical level. This critical level for flowering is specific for each variety and determines in part its area of adaptation and time of maturity. Adapted southern varieties flower too early to make maximum growth at day lengths less than 14½ hours.

The approximate day length at Stoneville, Miss., at each planting date is given in the following tabulation:

Planting date:	*Mean day length*
April 10	13 hr. 45 min.
April 20	14 hr.
May 1	14 hr. 25 min.
May 10	14 hr. 45 min.
May 20	15 hr. 10 min.
June 1	15 hr. 25 min.
June 10	15 hr. 30 min.
June 20	15 hr. 30 min.

At Stoneville a day length of 14½ hours is reached in early May (table 2). At this time minimum soil temperatures are above 65° F. and suitable for planting soybeans. In the gulf coast area of southern Alabama and western Florida a 14½-hour day is not reached until mid-May, although minimum soil temperatures have already been above 65° for some time. At a more northern location, such as Warsaw, Va., a 14½-hour day length is reached approximately 10 days after the last killing frost. Therefore, in the more northern sections of the southern region, soil temperature is the delaying factor, while in the extreme southern areas, day length is the most critical factor determining planting date.

Rainfall in the Spring

A third factor to be considered in determining planting date, along with soil temperature and day length, is moisture. In some areas rainfall in June is more erratic than in May. Consequently, late plantings may be hazardous from the standpoint of obtaining stands.

TABLE 2.—*Approximate date in the spring at which the day length reaches 14½ hours in different localities in the South*

Location	Latitude	Date
Warsaw, Va	37°59′	Apr. 25
Memphis, Tenn	35°03′	Apr. 26
Plymouth, N. C	35°52′	Apr. 28
Florence, S. C	34°13′	May 3
Stoneville, Miss	33°20′	May 5
Charleston, S. C	32°50′	May 7
St. Joseph, La	31°57′	May 8
Tifton, Ga	31°27′	May 10
Quincy, Fla	30°35′	May 15
Fairhope, Ala	30°32′	May 15
Baton Rouge, La	30°32′	May 15
College Station, Tex	30°35′	May 15
Belle Glade, Fla	26°40′	June 10

Plan of Studies

Four varieties of soybeans of different maturity levels were planted at approximately 10-day intervals from April 10 through June 20 for the years 1949, 1950, and 1951.

The varieties used were Wabash, S–100, Ogden, and Roanoke.[2] These four varieties represented the top-performing varieties of the maturity groups IV, V, VI, and VII, respectively. For convenience, soybean research workers classify soybean varieties in nine maturity groups, O to VIII. Groups O and I are adapted in the northern part of the United States. Succeeding groups are adapted farther south. Group VIII is adapted only in the extreme southern area of the country. Wabash, of group IV maturity, is a full-season variety in south-central Indiana. At Stoneville, Wabash, S–100, Ogden, and Roanoke would normally be classified as very early, early, medium, and medium late, respectively.

All plantings were made at a rate of 10 to 12 seeds per foot of row in 40-inch rows. With these varieties, this was at the rate of 50 to 60 pounds of seed per acre.

---

[2] In 1951 the strains now available as Perry, Dorman, and Jackson were planted at each date along with the four varieties discussed in this circular. The three varieties are very similar in maturity to Wabash, S–100, and Roanoke, respectively, and responded to the different planting dates in a manner similar to the older varieties of comparable maturity.

Results

Growth Rate

Germination and emergence rate of all varieties in the tests increased as the soil became warmer. With the cool temperatures encountered in the April 10 plantings, 12 to 14 days were required for emergence each year. After the minimum soil temperatures reached 65° to 70° F., only 5 to 7 days were required.

Height and width measurements were made at 42 days after emergence. At each planting date each year there was a difference among varieties. Roanoke consistently made most rapid growth and Wabash the slowest. However, all varieties responded to the time of planting in a similar manner. Rate of growth increased markedly as soil temperature at planting time increased (fig. 1). For the 3-year

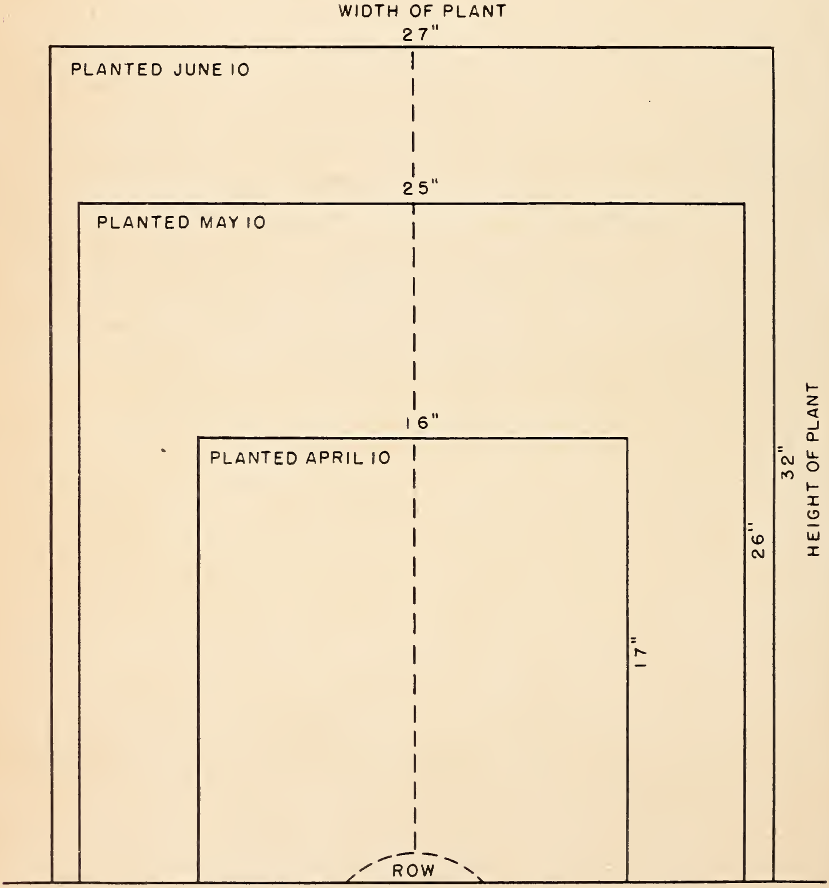


Figure 1.—Diagrammatic comparison of relative height and width at 42 days after emergence for the average of 4 varieties of soybeans planted April 10, May 10, and June 10, 1949–51.

period, these four varieties averaged 50 percent more growth at 42 days after emergence when planted May 10 than when planted April 10. One of the practical advantages of rapid emergence and more rapid early growth is in weed control. Under cold soil conditions, many weed seeds will germinate more rapidly than soybeans. With delayed planting fewer cultivations are required to keep the more rapidly growing beans free of weeds.

Time of Blooming

The time required from emergence to the stage when 50 percent of the plants were flowering is given in table 3. Regardless of time of planting, the early maturing variety Wabash began flowering approximately 30 days after emergence. The next earliest variety, S–100, also began flowering at a relatively uniform number of days after planting. However, Ogden and Roanoke required fewer days from emergence to flowering under the shorter day conditions following planting in April than when planted in early May. Roanoke required 47 days to reach the early-bloom stage when planted April 10, while 63 days were required when plantings were made May 1. In the early planting, nearly all the early flowers aborted.

Table 3.—*Approximate number of days from emergence to early bloom for 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1949–51*

Variety	Time of early bloom when planted on—							
	Apr. 10	Apr. 20	May 1	May 10	May 20	June 1	June 10	June 20
	Days	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*
Wabash	32	31	30	30	29	30	30	31
S–100	35	34	35	35	34	35	33	32
Ogden	55	49	60	56	53	51	47	39
Roanoke	47	41	63	60	58	55	51	44

Plant Height

The mean height of the three varieties, Wabash, Ogden, and Roanoke, was less when planted April 10 than when planted in May or early June (fig. 2).

The low height of Ogden and Roanoke in the early plantings can be attributed to early flowering under the short-day conditions and also to a slower growth rate with the lower soil temperatures. Initiation of flowering tends to limit further growth. When less growth resulted from early planting, the row middles were not completely shaded and more weed growth resulted. This growth difference is illustrated in figure 3.

Wabash, the earliest maturing variety, made its maximum growth when planted during May and then became shorter with each successive planting date after May 20. S–100 became decidedly shorter with planting dates after June 1, while Ogden and Roanoke show a drop in height in plantings made after June 10.

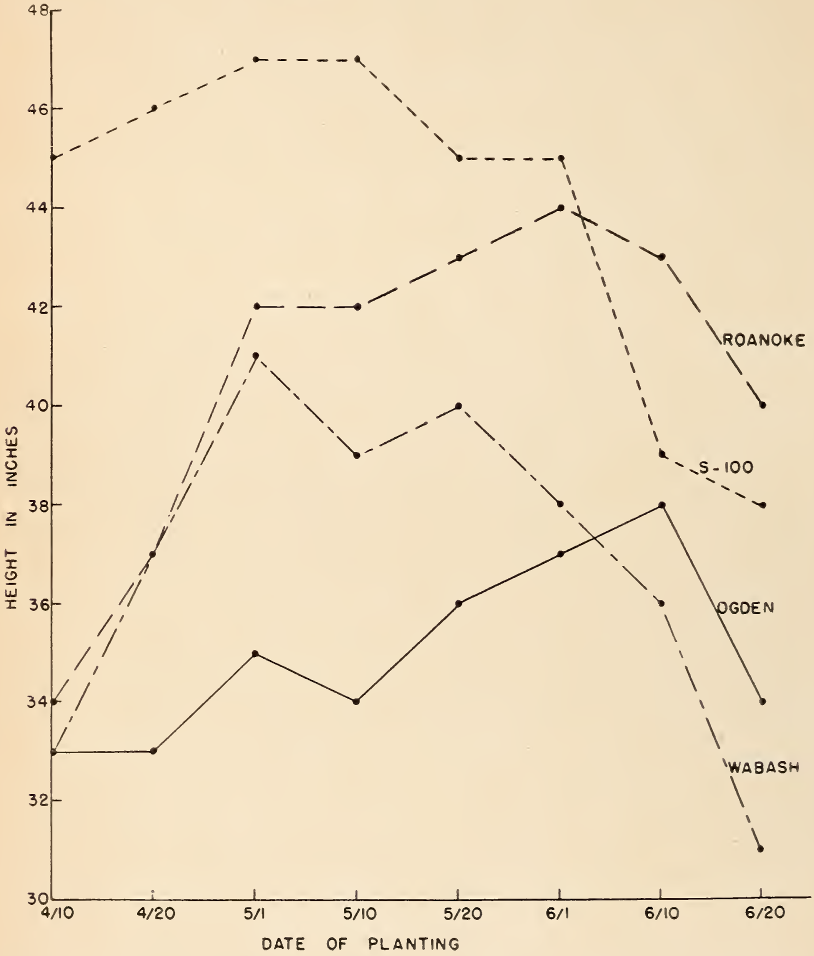


FIGURE 2.—Average height at maturity of 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1949–51.

Since the two later maturing varieties did not show a drop in height from late plantings until a later date than the two earlier maturing varieties, they are better adapted for late planting. As height is reduced in late plantings there is a tendency for pods to be formed closer to the ground. Therefore, a rather tall, medium-late or late variety can be harvested with less bean loss than a short variety.

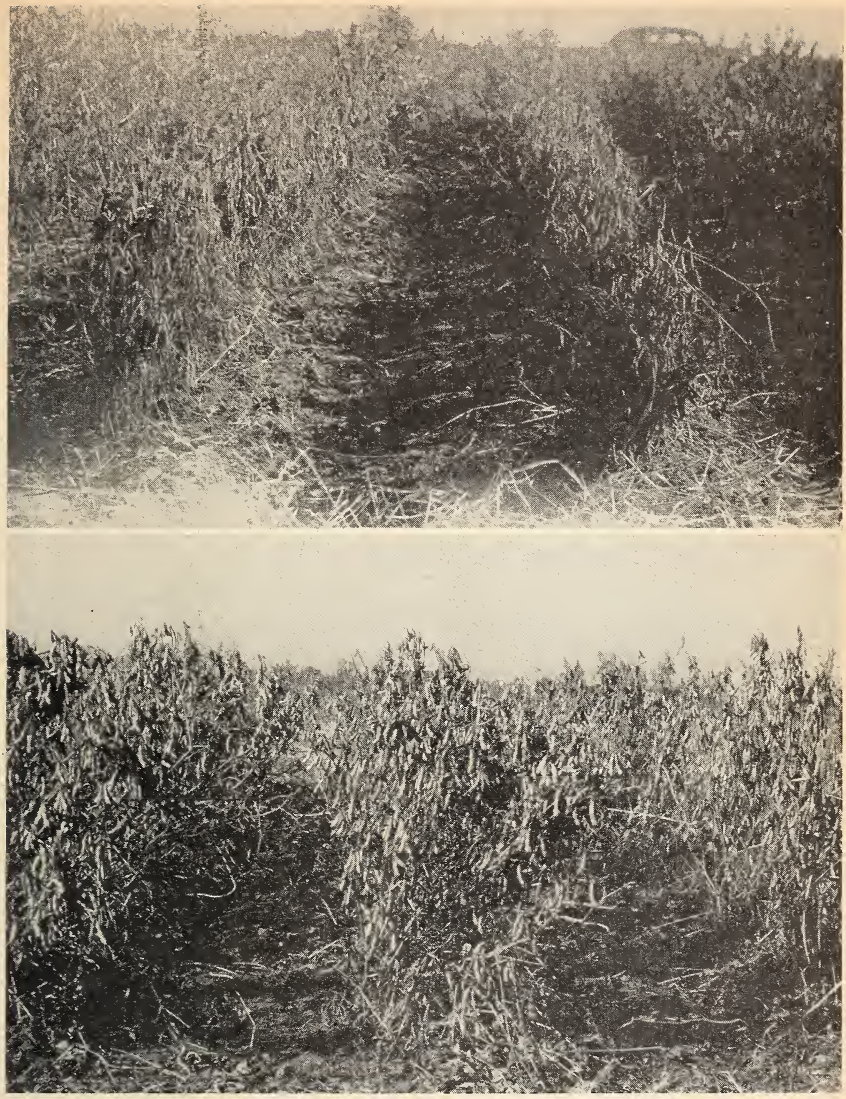


FIGURE 3.—Ogden soybeans planted April 10 (top) and May 1 (bottom), illustrating the stunted growth resulting from early planting.

Length of Fruiting Period

The period from flowering to maturity is herein termed "the fruiting period." Varieties, such as Ogden and Roanoke, that begin flowering relatively early in early plantings shed a high proportion of the early blooms. Very few pods are set on early plantings of these varieties previous to the time that early-May plantings begin setting pods.

The fruiting period for the medium-late variety Roanoke, when planted June 20, is longer than that of the early variety Wabash, when planted April 20 or May 1 (table 4). The fruiting period of Ogden planted June 20 is also longer than that of Wabash planted May 1.

TABLE 4.—*Average length of fruiting period for 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1949–51*

Variety	Time of early bloom to maturity when planted on—							
	Apr. 10	Apr. 20	May 1	May 10	May 20	June 1	June 10	June 20
	Days	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*
Wabash	89	84	76	74	74	62	60	58
S–100	102	100	88	87	82	78	74	74
Ogden	110	108	94	92	94	86	84	82
Roanoke	142	135	109	102	100	95	89	87

With all varieties, the fruiting period is shortened as planting is delayed. Roanoke planted June 20 has a slightly longer fruiting period than Wabash planted April 20 and May 1. It is shown later that Roanoke planted June 20 has produced a higher average seed yield than Wabash planted in late April or early May. On the basis of the results obtained in this study, it appears that a fruiting period of 90 to 110 days is needed for the production of maximum seed yields. With Wabash, the seed yield dropped sharply when the fruiting period was less than 70 days in the plantings made after May 20.

Date of Maturity

Soybean maturity is influenced by response to day length, temperature, moisture, and sometimes by leaf diseases. Maturity of the early varieties fluctuated more from year to year than did maturity of the later varieties (fig. 4).

Average maturity date for Wabash ranged from August 20, when planted April 10, to September 22, when planted June 20, a delay of 33 days for a 72-day delay in planting. For the same planting dates, Roanoke showed only a 5-day difference in maturity.

Maturity for the earlier plantings of all varieties except Roanoke was hastened in 1951 by a prolonged, late-summer drought. Maturity of the April plantings of Wabash and S–100 in 1949 was hastened by defoliation from two bacterial leaf diseases, bacterial pustule and wildfire.

In 1950, when maturity was considered normal, there was very little difference in the maturity date of Wabash when planted April 10 and May 10, of S–100 when planted April 10 and May 20, or of Ogden when planted April 10 and June 1. Consequently, for the grower who wishes to harvest a large acreage with a combine, dividing the acreage between two varieties such as Ogden and Roanoke is a surer method of spreading harvest dates than planting one variety over a range of planting dates.

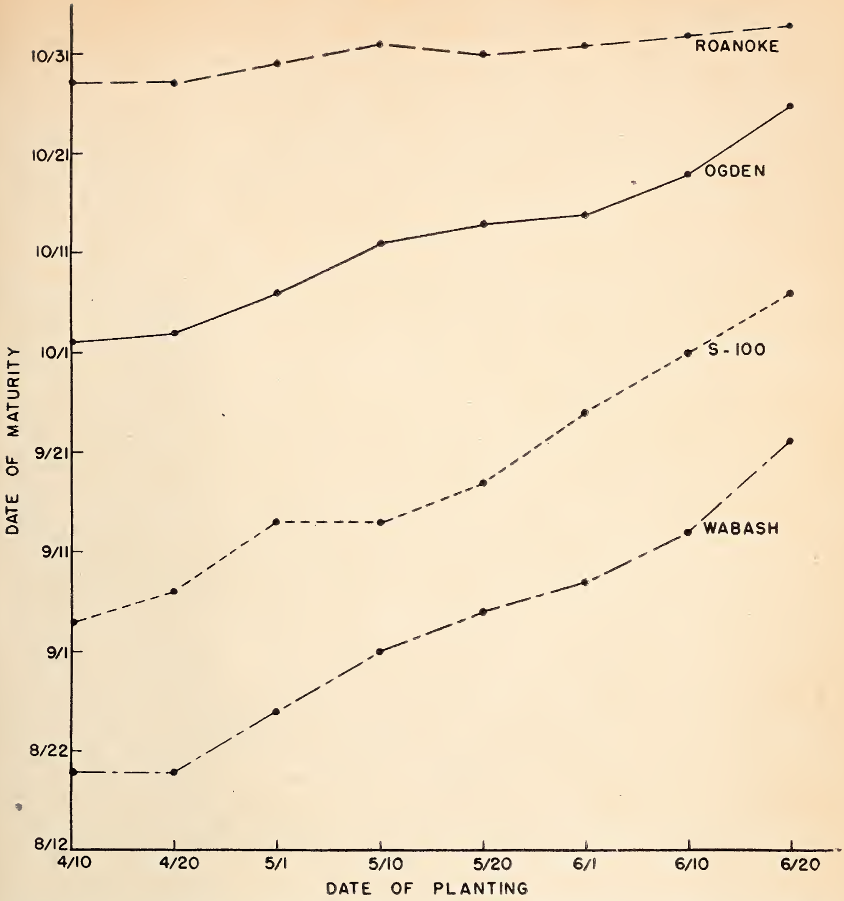


FIGURE 4.—Average maturity dates for 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1949–51.

The length of growing season for the four varieties at the different planting dates is given in table 5.

TABLE 5.—*Average number of days from emergence to maturity for 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1949–51*

Variety	Length of growing season when planted on—							
	Apr. 10	Apr. 20	May 1	May 10	May 20	June 1	June 10	June 20
	Days	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*
Wabash	121	115	106	104	103	92	90	89
S–100	137	134	123	122	116	113	107	105
Ogden	165	153	154	148	148	137	131	121
Roanoke	189	176	172	162	158	150	140	131

Seed Yield

The highest mean yield for each of the four varieties for the 3-year period was obtained from the May 1 planting date (fig. 5). This was the earliest date possible for planting at Stoneville after minimum soil temperature had exceeded 65° F. and the day length approached 14½ hours. With medium to medium-late varieties, there is a considerable range over which they may be planted with little reduction in yield.

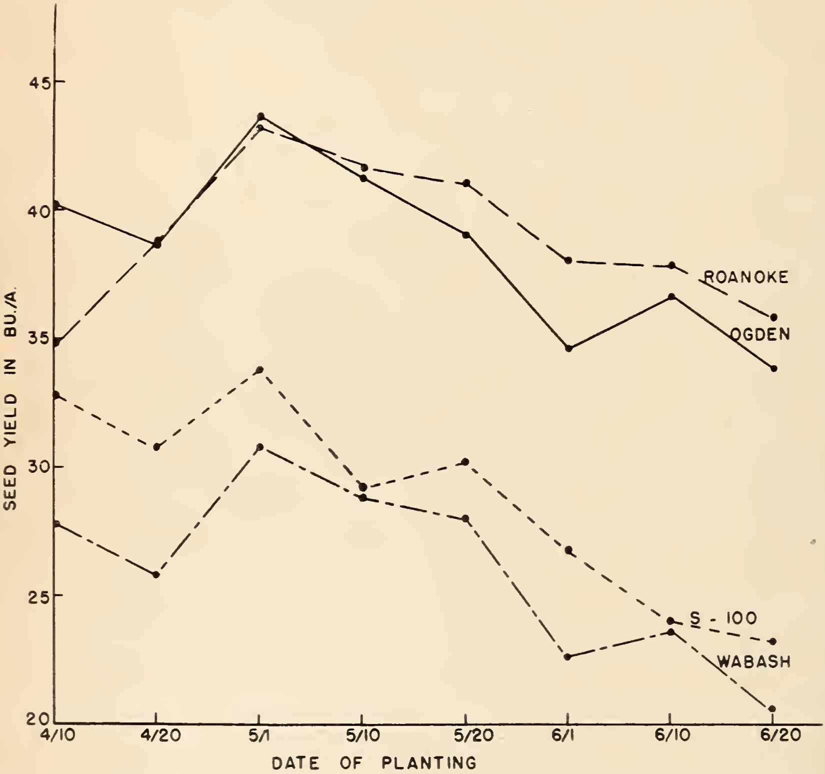


Figure 5.—Average seed yield for 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1949–51.

The seed yield of Roanoke was adversely affected by early-April planting. This planting date gave early flowering and reduced growth. Roanoke yields were reduced less by late planting than were those of Ogden, a slightly earlier maturing variety. Roanoke planted on June 20 produced higher seed yields than Wabash or S–100 planted on May 1. It was pointed out earlier that Roanoke in the late planting had a fruiting period greater than Wabash at the May 1 planting.

The rapid drop in yield produced by Wabash when planted after May 20 coincides with a marked decrease in length of fruiting period. With this variety it appears that a fruiting period of more than 70 days is required to produce a fair yield. With S–100 the minimum requirements may be greater. These factors should be kept in mind when choosing a variety and a planting date.

In areas with a long growing season where a system of double-cropping is used, in which soybeans are planted late after white potatoes or small grain, higher seed yields can usually be expected from medium- or medium-late maturing varieties than from early maturing ones.

Seed Quality

The better adapted (i. e., later maturing) varieties, Ogden and Roanoke, consistently produced better seed quality than the earlier varieties. All varieties produced better quality seed from May plantings than from April plantings. With the very early and early varieties, there was a tendency for seed from late plantings to be of poor quality.

Chemical Composition of the Seed

Over the range covered in these experiments, planting date had very little influence on oil content, protein content, or iodine number of the oil. Oil content showed little variation among years for each variety (fig. 6). This was particularly true for planting dates giving the highest seed yields.

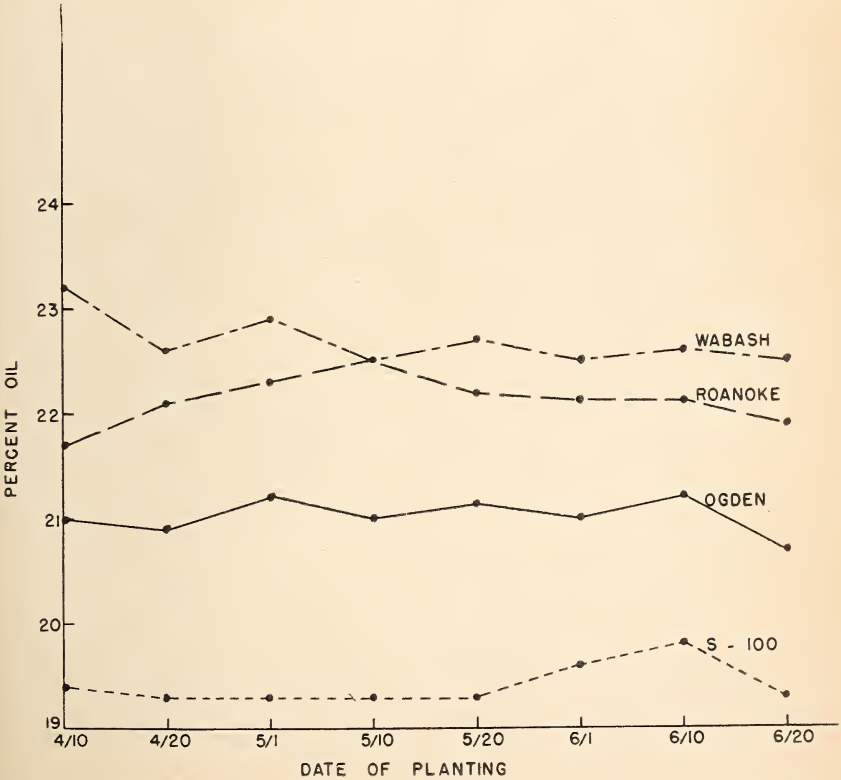


FIGURE 6.—Average oil percentage, expressed on a dry-matter basis, for 4 varieties of soybeans planted at 10-day intervals at Stoneville, Miss., 1940–51.

WEST FLORIDA RESULTS[3]

A 14½-hour day length is attained at gulf coast locations, such as Fairhope. Ala., and Quincy, Fla., about May 15 (table 2). It has been suggested that soybean planting should be delayed until after this day length is attained. Yield data were obtained from the Ogden and Roanoke varieties when planted at 15-day intervals, beginning April 15, at Walnut Hill, Fla. (fig. 7). Highest yields for both varieties were obtained from June 1 plantings. Roanoke produced almost as many bushels when planted June 15.

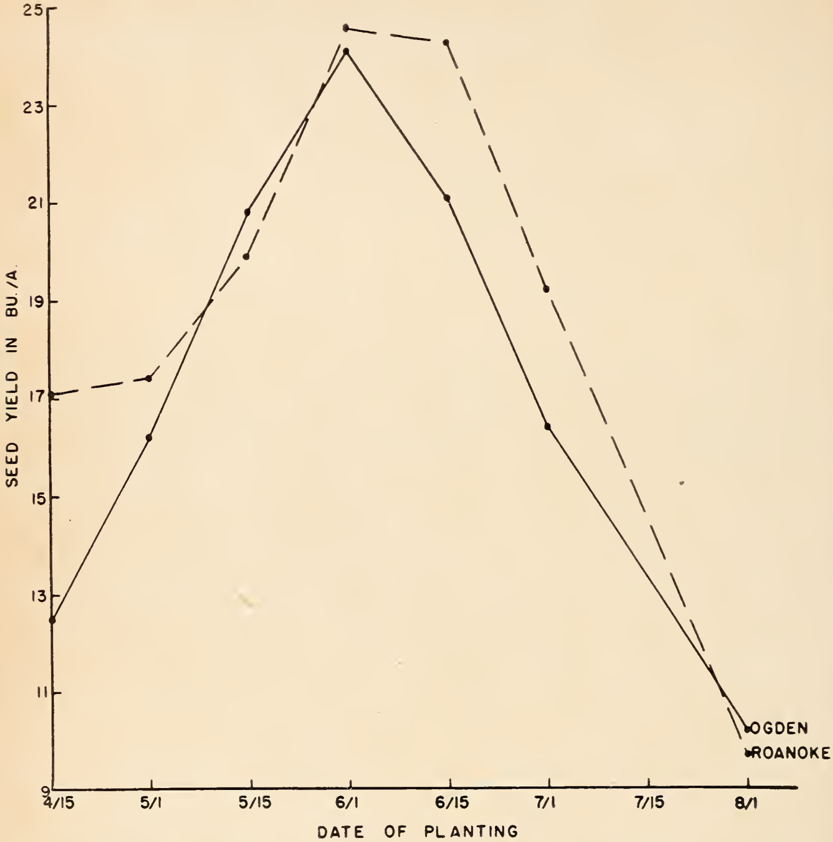


FIGURE 7.—Seed yields for 2 varieties of soybeans planted at 15-day intervals at Walnut Hill, Fla., 1952.

SUMMARY

A time-of-planting study conducted at Stoneville, Miss., with four varieties of soybeans gave very similar results each year for the 3-year period 1949–51, even though moisture conditions differed by seasons.

Optimum planting date for the Southern States appears to be that date when the minimum soil temperature attains 65° F. and after the day length reaches or exceeds 14½ hours.

---

[3] Walnut Hill, Fla., data furnished through the courtesy of Ralph Smith, associate agronomist, Florida Agricultural Experiment Station Mobile Unit No. 2.

Planting under such conditions will give more rapid emergence, more rapid growth, higher seed yields, and better seed quality than earlier planting. Rapid emergence and rapid growth should contribute to greater ease in weed control.

Medium- and medium-late maturing varieties show less reduction in bean yield from late plantings than do short-season varieties. A delay of 72 days in planting delayed maturity of Wabash 33 days; S–100, 33 days; Ogden, 24 days; and Roanoke, 5 days. Therefore, in a double-cropping system, where soybeans are planted late following white potatoes or small grain, a medium-late maturing variety will usually give higher seed yields than earlier maturing varieties, and its maturity will closely approximate its normal maturity date for earlier plantings. Since height is reduced in late plantings and pods are formed closer to the ground, less harvesting loss will usually be encountered in very late plantings by utilizing tall varieties of medium, medium-late, or late maturity.

Seed yield data from a date-of-planting study made at Walnut Hill, Fla., are in agreement with the conclusions drawn at Stoneville, Miss.

U. S. GOVERNMENT PRINTING OFFICE: 1954